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Week Long Physical Activity

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Abstract

We explored 10 11 year-
distributed within weekdays, weekend days, the segments of a schoolday and how it meets the global ; 20 boys, 13 girls)
in the city of Vantaa, capitol area of Finland. PA was measured using a Polar Active® (PAC) wrist-worn accelerometer. A diary supported the accelerometer data. Raw metabolic equivalent (MET) data from accelerometers were transmitted to computer, organized and uploaded to SPSS. We used MET-thresholds moderate PA (MPA) ntly modera .
Average daily MVPA was 92 minutes. Differences between weekdays and weekend days existed, but they were at least partly caused by the weather. Global recommendation was met by 21%, more often by girls than boys. How 4 a week. In segments of the schoolday (lessons, long recesses, short recesses and lunch breaks) the children were physically quite active at 5, 12, 4 and 8 minutes, respectively. Hypothetically summed up, a schoolday accumulated 50 minutes MVPA. Boys accumulated quite systematically slightly more MVPA during schooldays and leisure time. Schooldays play an important role in teacher educators, decision makers, school administration, principals, teachers and school staff should still aim at finding new ways of making schooldays even more physically active.

Keywords: Physical activity; children; objective measurement; schoolday; segments.

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1. Introduction

-being are an interest of current studies and so worth widely documented. PA is positively connected with well-being of school-aged children, in terms of physical, psychological, social and cognitive health indicators (Bangsbo et al. 2016; Hinkley et al. 2014; Janssen & LeBlanc, 2010; Marques, Santos, Hillman & Sardinha, 2018; Poitras et al. 2016). These associations are interdependent in various ways, and the intensity of PA seems to be important, because the relationships are more consistent and robust on moderate to vigorous levels (MVPA) of PA. However, even light physical activity (LPA) has benefits among physically inactive and high-risk children; increasing PA appears to result in more benefits (Janssen & LeBlanc, 2010; Poitras et al. 2016.) Altogether, different PA patterns like sporadic, bouts and continuous PA seem to provide benefits through various mechanisms (Poitras et al., 2016).
global recommendation on physical activity for children and adolescents aged 5 to 17 years include the pursuit to accumulate daily at least 60 min of moderate- to vigorous-intensity PA (MVPA) , including vigorous PA and muscle/bone strengthening activities at least three times in a week. (WHO, 2010, pp.17 21). It has also been suggested, that at least half of this minimum time should be accumulated during the schoolday (Institute of Medicine, 2013).

Caspersen, Powell and Christenson efinition of physical activity as any physical movement generated by skeletal muscles which expends energy
daily PA includes school transportations, lessons and recesses during school day and organized or unorganized physical activities like sports and hobbies during their leisure time (WHO, 2010, p. 20).

PA has been measured using subjective and objective measurements. Subjective, self-reported instruments are needed, especially when studying attitudes, contents, environments of PA and PA of large populations (Biddle, Gorely, Pearson & Bull, 2011; Steene-Johannessen et al., 2016) and long-term studies (Golubic et al., 2014). Objective PA measurements in the field environments, like schools and leisure time surroundings, are mostly conducted with different kinds of accelerometers (Sherar et al., 2011) that quantify frequency, intensity and duration of PA and make it possible to estimate energy expenditure (Ekblom et al., 2012). Both subjective and objective measurements have their own strengths and weaknesses. Implementing a combination of these methods in large-scale studies and surveys is recommended (Steene-Johannessen et al., 2016) and small population studies may benefit of both methods receiving versatile data of PA, not only of energy expenditure.

When using objective measurements, the time spent on different intensity levels are of interest. In a large-scale Finnish study, 9, 11, 13 and 15 year-old children accumulated every day, on an average, 128, 114, 88 and 74 minutes (henceforth min) MVPA, respectively. Most of the accumulated

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MVPA was on the moderate intensity level (Husu, Jussila, Tokola, Vähä-Ypyä & Vasankari 2016, p.21.). Haapala et al. (2016) registered an average of 70 min MVPA among 7 to 12-year-old Finnish children. Two British studies, among 9 to 10-year-old children, found that boys accumulated MVPA approximately 80 min and girls 15 min less per day (Owen et al., 2009; Steele et al., 2010). Slightly lower results were found in another British study, when 8 to 9-year-old boys accumulated 69 min and girls 56 and MVPA per day (Jago et al., 2017). Furthermore, somewhat higher readings were found in a longitudinal study in USA, where of 9, 11, 13 and 15-year-old children were physically active daily on the MVPA level for approximately 182, 124, 96 and 49 min, respectively (Nader, Bradley, Houts, McRitchie, & 2008).

In addition to studying the amounts of PA on different intensity levels, the genre of studying the proportions of children meeting the global recommendations gives us a better insight on sufficient

tions on

Physical Activity, has been widely studied. The report of global assessment on reaching the recommendations of 5 17-year-old children revealed the spectrum of studies varying in sizes, ages, measurements and settings (Aubert et al., 2018). Because of these differences, the report gives a roughly painted picture of ch be reached exploring age-specified studies.

According to a large-scale Finnish study, 39% of 11-year-old, 26% of 13-year-old and 17% of 15 year-old children and youth self-reported to accumulate daily 60 min MVPA, when the proportions of boys and girls were 46 and 33%, 31 and 21%, 21 and 13%, respectively. Almost all of 11- and 13-year-old children reached the level of at least three days in a week, when the proportion among 15-year-old youth was 82%. (Kokko, Mehtälä, Villberg, Ng & Hämylä, 2016, p.13). The objective measurements ended up with similar results with the exception that differences between boys and girls were wider, especially during the ages of 11 to 13 (Husu et al., 2016, p.21). The percentages of reached recommendations decreased systematically by age (Husu et al., 2016, p.21; Kokko et al., 2016, p.13). In a British study, the proportions were somewhat higher, when 60% of girls and 81% of boys among 9 to 10-year-old UK children met the PA recommendations (Steele et al., 2010).

These results align with the studies showing at least two trends. Firstly, there appears to be a

PA is that boys tend to be more physically active than girls (Aubert et al., 2018; Haapala et al., 2014; Husu et al., 2016, 21; Jago et al., 2017; Nader et al., 2008; Steele et al., 2010).

Comparing MVPA during weekdays and weekends, and more precisely within a schoolday, gives us a Converse differences between PA during

schooldays and weekend days have been presented. Owen et al. (2009) found that 9 to 10 year-old was lower at weekends, especially on Sunday, when Noonan, Boddy, Kim, Knowles, & Fairclough (2016) reported that the PA of same aged children accumulated slightly more MVPA during weekdays than weekend days. Using the accumulated vigorous PA, Steele et al. (2010) did not find any differences when comparing weekdays and weekends. Trost, Pate, Freedson, Sallis, & Taylor (2000) found that 6 to 11-year-old boys were physically more active during weekend days compared to weekdays. When getting older, the weekend PA turned to be lower than weekday PA (Trost et. al. 2000.)

schooldays is important when pursuing to meet the recommendations of PA and thus enhancing the multiple benefits of PA (Bangsbo et al., 2016; Hinkley et al., 2014; Janssen & LeBlanc 2010; Marques et al., 2018; Poitras et al., 2016). It has been suggested that MVPA during schooldays should be 30 min covering half of the minimum recommendation level (Institute of Medicine, 2013). However, the amounts of MVPA during the school day are difficult to compare because of the different lengths of the school days, lessons and recesses. Nettlefold et al. (2010) found that 8 to11 year-old children in Canada accumulated 53 64 min MVPA during the whole six lesson schoolday in line with 6 to11 year- , 2018). Slightly less MVPA (30 min) was reported of Finnish 7 to 12-year-old children five-hour schoolday (Haapala et al., 2016) and 6 to 9-year-old children from US, accumulating approximately 30 min MVPA on a schoolday (Weaver et al., 2016). Boys were systematically slightly more physically active than girls during a total schoolday.

Lessons of approximately 45 minutes are quite common. During class lessons in the Czech Republic, 9 to 11-year-old children accumulated approximately 2 3 min MVPA (Sigmund , 2014) in line with the 7 to 12 years- MVPA 1 3 min (Suzuki et al., 2018) and American 6 9-year- 3 min MVPA (Weaver et al., 2016). Somewhat more physical activity was measured in the UK, when boys and girls, aged 10 to 14 years accumulated approximately from five to six min MVPA during a lesson (Bailey et al., 2012). Boys were systematically slightly more physically active than girls were during lessons.

Recesses appear to be important segments of accumulating MVPA during a schoolday. The lengths of the recesses vary usually between 15 and 45 min, which makes it complicated to make comparisons of their physical efficiency. English 5 to 10-year-old children accumulated 22 to 28 min MVPA during 85 min recesses (Ridgers, Stratton, & Fairclough, 2005). During 20 25 min recesses, children between the ages 7 and 14 accumulated 4 to 5 min MVPA in Canada (Nettlefold et al., 2010), 6 to 8 min per day in America (Weaver et al., 2016), around 3 min in the Czech Republic

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(Sigmund et al., 2014), 4 5 min in Japan (Suzuki et al., 2018) and in Britain about 5 8 minutes (Bailey et al., 2012). However, there are small differences depending on the age groups in the studies. The proportion of VPA, when reported, was approximately 20-30 % of the MVPA. (Bailey et al., 2012; Ridgers et al., 2005; Suzuki et al., 2018). Boys were systematically slightly more physically active compared to girls.

Lunch breaks are for having a meal and taking a break; therefore, the time available for PA depends on how fast or slow the child eats. The lengths of the lunch breaks vary usually between 30 to 65 min. Canadian 8 to 11-year-old children accumulated around 15 min MVPA during a 35 to 50 min lunch break (Nettlefold et al., 2010). Slightly less MVPA during a 40 to 45 min lunch recess was measured, when 7 to 12-year-old Japanese children were physically active for 12.6 min (Suzuki et al., 2018), similar to British 10 to 14-year-old boys who accumulated approximately 15 min MVPA during a 45 min lunch break (Bailey et al., 2012). Much higher readings were registered when 7 to 8-year-old American children were physically active from 15 to 26 minutes during a 45 to 60 min lunch break (Weaver et al., 2016). Boys were systematically slightly more physically active during lunch breaks.

2. Purpose of this study

The purpose of this descriptive study is to analyze 10 to 11-year-old a period of one week. We aimed to find how the PA is distributed within the segments of school and leisure time. This information is important for teacher educators, decision makers, school administration, principals, teachers and school staff and projects implemented during schooldays and leisure time, to enhance the total well-being of children.

3. Research Questions

More precisely, we aimed to explore the overall MVPA of 10 to 11-year-old children and how it meets the recommendations of 60 min daily MVPA.

Additionally, we wanted to explore how the MVPA is divided between weekdays, weekend days and especially the segments of the schoolday. The differences between boys and girls were also of interest to us.

4. Research Methods

4.1. Participants and procedure

The participants were 33 children (20 boys and 13 girls) of two separate fourth grade classes, aged 10 to 12 years (mean 10.2 yr. STD 0.5 yr.) in one primary school in the city of Vantaa, located in the capital district area of Helsinki, Finland. All children (N = 39) were invited to participate in this study, but, six children were later excluded from the analysis because of insufficient data.

Permissions from the city of Vantaa, teachers of the classes, principal of the school, the caregivers and the children were obtained. Before giving their permission, the caregivers received an information sheet about this study where it was would be measured using a wrist-worn accelerometer for consecutive seven days and nights. Washing, showers, sauna and swimming were allowed. Additionally, children were asked to keep a diary. Parents were asked to fill in the sheet with information of their child (sex, birth date, height and weight), so we were able to adjust the settings of the accelerometers individually.

4.2. Measurements

Data collection took place at the end of March 2015. Children received their individually adjusted accelerometers on Monday and the measurement started on next night at 24:00 and ended the following Monday at 24:00, resulting a total period of seven days and nights and supplying us with the data of Monday after the weekend.

We used a Uniaxial Polar Active® (PAC) wrist-worn accelerometer (Polar Electro Ltd, Finland). It records the PA data in 30 second epochs and calculates the energy expenditure in METs (metabolic ge, height and weight. The device is additionally a wristwatch showing the time. PAC filters and classifies the acceleration signals to different activity zones: very addition to steps, energy expenditure and sleep time can be viewed in the monitor and is easily accessed and interpreted. In some validation tests, PAC was found to be an accurate and valid device to measure energy expenditure in hiking and intensive training (Brugniaux et al., 2010; Kinnunen, Tanskanen, Kyröläinen, & Westerterp, 2012). However, differences between the forms of physical activity and the placement of the accelerometer are likely to cause different kinds of results (Kim, Lee, Peters, Gaesser, & Welk, 2014; Noonan et al., 2016). PAC display includes a human figure lying, sitting, standing, walking or running according to the PA (Polar, 2010). This kind of feedback may motivate children to be more physically active than is normal. Some evidence has been presented that

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accelerometers may increase youth activity levels (Ridgers, McNarry, & Mackintosh, 2016). To avoid this bias, the first day data (Monday) were ignored.

We asked the children to wear the device on the wrist of their writing hand for seven consecutive days and nights. Children tend to like to wear wrist-worn accelerometers (Ridgers et al., 2016) and their compliance compared to hip placed devices is remarkably high (Fairclough et al., 2016). The adjustments of the PAC monitor were locked, to avoid loss of the data. However, children were able to scan their PA data in the monitors.

In addition to the objective data attained with the accelerometers, we used a 7x24 h diary to collect desc -
reported instruments have been found to give information especially about the quality and environments of the physical activities (Steene-Johannessen et al., 2016). Our diary included the same information about the study as their parents received earlier, and additional questions of timings, contents and environments of PA during lessons, recesses, lunch breaks and leisure time until they went to sleep. Children were advised to fill in the diary upon waking up, arriving at school, completing the school day and, in the evening, when going to bed. Additionally, they were advised, if needed, to ask for assistance from their caregivers or teacher to fill in the diary.

Daily weather during measurement week was typical for the early spring in Southern Finland at the end of March: Tuesday; sunshine, 6 8ºC, Wednesday; cloudy, wet snow, -1 1ºC, Thursday; sunny, 0 2ºC, Friday; cloudy, rain, 1 3ºC, Saturday; cloudy, rainy 1ºC, Sunday; cloudy 1ºC, Monday; cloudy, wet snow 0ºC.

4.3. Data reduction

At the end of the study period, we collected the devices from all of the children, but excluded six of them due to insufficient data. Additionally, we excluded the first day (Monday) data, because it is usually biased as the children tend to be excited with the new device and start doing unusual movements and exercises to test the device.

The data from the monitors was transmitted into the Polar Gofit web service (https://polargofit.com) using an usb-connected flow-link device. Instead of using the readily categorized MVPA data given by the system, which is easy and convenient in many cases, we downloaded the raw MET-data in Excel-format to the computer. There, we organized it according to days and segments of the schoolday and uploaded it to IBM SPSS Statistics 24 for further analyses. We calculated the values of physical activity in moderate to vigorous intensity zones. Thresholds in our study were widely used and suggested by WHO (2010, p.16) as follows: Moderate PA (MPA)

, moderate to vigorous PA (MVPA) suggests slightly different thresholds (Polar, 2010). The example activity of MPA is brisk walking and slow running of VPA (Hildebrand, Van Hees, Hansen, & Ekelund, 2014; Polar, 2010; Phillips, Parfittb, & Rowlands, 2013; Schaefer, Van Loan, & German, 2014).

Thirty seconds epochs were changed to minutes of PA into different zones of MVPA. Means of minutes of MVPA during the whole week, weekend days and segments of each schoolday, including lessons (45 min), recesses (15 and 30 min) and lunch breaks (35 min), were analyzed in different zones. The percentages of meeting the recommendations of daily MVPA were counted.

The 45 min lessons in the analysis were: Mother language (f=2), Mathematics (4), Environmental Studies (1), Religion/Ethics (2), Physical Education (2), Music (1), Visual Arts (2) and Crafts (2). At first, we calculated the MPA, VPA and MVPA means of each subject and analyzed them. enting the MPA, VPA and MVPA accumulated during one standard lesson. We similarly calculated the means of both short (6) and long (2) recesses and lunch breaks (4) to present the standards of them examined with One-Way Anova.

5. **Results**

5.1. Overall MVPA

MVPA of 10 to 11 year-old children in this study, during the period of a whole week, weekend and separate weekdays are presented in Table 1. Children accumulated on an average 92 min MVPA, during the whole week, 104 min during the weekdays and 60 min during weekend.

Table 1. Averages of MVPA (min) during the whole week, weekdays and weekends.

		N	**M**	**SD**	**Mdn**	**Min.**	**Max.**	**Girls**	**Boys**
MVPA Moderate to Vigorous	Whole Week	33	91,9	29,9	93,3	46,3	158,1	91,2	92,4
	Weekdays	33	103,7	32,1	101,7	52,6	170,0	103,2	104,1
	Weekend	33	59,9	35,9	58,0	12,5	163,0	58,6	60,0
	Monday	31	83,6	51,1	70,5	19	241,0	82,9	84,2
	Tuesday	33	123,8	49,1	113,0	65,0	247,0	122,8	124,4
	Wednesday	33	97,8	37,8	93,5	31,5	181,0	97,0	98,3
	Thursday	32	126,5	34,3	124,0	69,5	183,5	125,9	126,9
	Friday	32	86,8	26,4	86,5	44,0	129,5	88,0	86,0
	Saturday	30	53,9	33,1	48,0	13,0	140,5	62,8	48,0
	Sunday	31	71,3	46,6	67,5	12,5	185,5	58,4	80,6

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	Whole Week	33	21,2	12,3	19,0	4,5	62,2	17,7	23,4
	Weekdays	33	25,5	15,2	23,1	6,9	72,7	20,8	28,0
	Weekend	33	9,8	8,8	8,3	0,0	36,0	7,3	11,3
MVPA	Monday	31	16,4	19,6	10,0	1,0	96,5	16,2	16,5
	Tuesday	33	34,3	29,4	25,0	7,0	152,0	26,3	39,5
Vigorous	Wednesday	33	22,5	14,9	19,5	4,5	72,0	18,2	25,3
	Thursday	32	35,3	23,4	30,8	3,5	104,0	32,6	37,0
	Friday	32	18,6	11,2	15,3	5,5	46,0	16,8	19,9
	Saturday	30	6,5	5,1	6,0	0,5	22,0	7,8	5,7
	Sunday	31	14,1	15,9	10,0	0,0	64,0	**7,4**	**18,9***
	Whole Week	33	70,7	22,4	67,8	37,4	130,9	73,4	69,0
	Weekdays	33	78,2	22,5	79,2	43,4	128,5	81,4	76,2
MVPA	Weekend	33	49,7	29,7	47,8	12,3	136,8	51,3	48,7
	Monday	31	67,3	36,0	60,0	18,0	178,5	66,7	67,7
Moderate	Tuesday	33	89,5	30,2	91,0	48,0	153,5	96,5	84,9
PA MET	Wednesday	33	75,3	30,2	72,5	26,5	161,5	78,8	73,0
6	Thursday	32	91,2	22,8	87,0	50,0	138,5	93,3	89,9
	Friday	32	68,2	18,7	73,3	34,5	101,0	71,2	66,1
	Saturday	30	47,4	29,8	41,0	11,5	124,0	54,9	42,4
	Sunday	31	57,2	35,5	48,0	12,5	149,5	51,0	61,7

Statistically significant difference between girls and boys is bolded.

Comparing the MVPA during different days of the week, children appeared to accumulate most MVPA on Tuesday (124 min) and Thursday (127 min), when Saturday (54 min) and Sunday (71 min) were physically the most inactive days of the week. Girls (63 min) seemed to be slightly more physically active than boys (48 min) were on Saturday. However, boys accumulated more MVPA on Sunday (81 min) compared to girls (58 min) and on the VPA level the difference was statistically significant ($p = 0.046$). Altogether, boys accumulated MVPA minutes slightly more on the VPA level than girls did, during the whole week. The ranges of PA on all intensity levels are remarkably wide as shown in Table 1.

5.2. Meeting the global recommendations on physical activity

The global recommendation is to be physically active daily, on at least attain moderate levels, of a minimum of 60 min. In our study, this recommendation was met by 21% of 10 to 11-year-old children, when the proportions of girls and boys were 31 and 15% respectively (Table 2). However, almost 85% of the children were physically active, at least at a moderate level, four times in a week or more often. Except on Saturday, more than half of the children met the recommended levels. On Tuesday and Thursday, every child exceeded the 60 min MVPA threshold, when during the weekend, just approximately every second child reached that level (Table 2).

Table 2. The prevalence (%) of meeting the recommendation 60 min MVPA.

	Total	**Girls**	**Boys**
0-3 times/week	15,2	15,4	15,0
4-6 times/week	63,6	53,8	70,0
daily	21,2	30,8	15,0
Monday	67,7	69,2	66,7
Tuesday	100,0	100,0	100,0
Wednesday	84,8	84,6	85,0
Thursday	100,0	100,0	100,0
Friday	81,3	76,9	84,2
Saturday	40,0	58,3	27,8
Sunday	54,8	46,2	61,1

5.3. Schoolday MVPA

The amounts of accumulated MVPA during various subjects varied between 1.9 and 8.7 min per lesson. Because there were only 1 4 lessons per subject, the separate results are not discussed. However, we combined them, including physical education, into a explained earlier in subsection 3.3. The findings of MVPA during the schoolday segments are presented in the Table 3. Children accumulated, on an average, 5 min MVPA during a lesson. Altogether, the ranges of both on MPA and VPA intensity levels compared to girls during the schoolday segments.

Table 3. Means of MVPA, VPA and MPA (min) during the segments of the schoolday

	Intensity	**MET**	**N**	**M**	**SD**	**Mdn**	**Min.**	**Max.**	**Girls**	**Boys**
Lesson 45 min	MVPA		33	5,0	2,1	4,5	1,0	9,5	4,8	5,1
	VPA		33	1,4	0,8	1,2	0,1	3,7	1,2	1,5
	MPA	6	33	3,6	1,5	3,5	0,9	7,3	3,6	3,6
Long recess 30 min	MVPA		33	12,4	4,6	12,3	4,0	20,8	10,8	13,5
	VPA		33	4,3	2,7	4,0	0,5	11,0	3,3	5,0
	MPA	6	33	8,4	2,9	8,8	3,8	14,0	7,7	8,9
Short recess 15 min	MVPA		33	4,3	1,5	4,1	2,1	8,1	3,8	4,6
	VPA		33	1,3	0,9	1,2	0,3	3,9	1,0	1,5
	MPA	6	33	2,9	0,9	2,8	1,7	4,6	2,7	3,1
Lunch break 30 min	MVPA		33	8,0	3,3	8,1	1,5	16,9	**6,2**	**9,2****
	VPA		33	2,7	1,8	2,4	0,0	7,4	**1,8**	**3,3***
	MPA	6	33	5,3	2,0	4,9	1,5	10,4	**4,3**	**5,9***

Statistically significant differences between girls and boys are bolded.

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Children accumulated during a long recess, on an average, 12 min; short recess- 4 min and lunch break- 8 min MVPA. During the lunch breaks, the differences between boys MVPA were statistically significant ($p = 0.006$) as well as of VPA ($p = 0.019$) and MPA ($p = 0.020$).

Lengths of the schooldays varied in this study, because some lessons are common to all of the children, some subjects are taught in other groupings, depending on their native language, religion or study choices. This made it difficult to calculate the actual schoolday MVPA. Therefore, we decided to build a picture of an ordinary schoolday MVPA using the means of the schoolday segments in this study. According to the basic school decree, the minimum amount of 45 min lessons per week at the fourth grade level is 24. When counting
primary school, the schoolday would be scheduled as follows: lesson (45 min), lesson 45 (min), recess (30 min), lesson (45 min), lunch break (30 min), lesson (45 min), recess (15 min), lesson (45 min). Using the means of the schoolday segments (Table 3), the theoretical MVPA min of a schoolday would be 5 + 5 + 12.4 + 5 + 8 + 5 + 4.3 + 5 = 49.7 min.

6. Discussion

This study aimed to explore 10 to 11-year- PA during a period of one week, to find

wanted to find out if there are differences between schooldays and weekends and during separate weekdays. Additionally, we aimed at studying the MVPA during the segments of a schoolday.

Before discussing the results, some limitations of the study need to be stated. The particular strength of this study was the use of wrist-worn accelerometers. Measuring PA objectively for seven consecutive days and nights provided us with versatile data. Polar Active accelerometers (PAC) appeared to be easy and feasible for the use of children, which minimized the occasions of taking them away from their wrists. The data were easily accessed and interpreted compared to accelerometer counts used in many accelerometers (Van Cauwenberghe, Jones, Hinkley, Crawford, & Okely, 2012). However, while walking and running kinds of activities were probably well
ime appeared to be
underestimated, because the movements are mainly feet- instead of hand-centered. The diaries provided us with the possibility to check if the children had some special program or occasions during the week of measurements. For instance, some children were sick for few days and their coach ordered some to take the device away during a training session or competition, which lowered the accumulated MVPA minutes. That being said, parents and teachers should be involved in assisting

children to fill in the diaries more systematically. Availability of raw MET-data made it possible to focus the analyses on particular segments of the day, single lessons, recesses and lunch breaks. This made the use of different thresholds or intensity levels possible. The duration of this study was seven days and nights. A longer period and more stable weather would have helped to gather more valid data. The beginning times, subjects, number of lessons per day and the ending times of the schooldays varied greatly. Thus, we were not able to calculate schoolday MVPA objectively. Instead, we decided to add up a theoretical schoolday, which is not comparable with other studies. However, it might be one way of comparing the schooldays in the future.

6.1. Overall MVPA

The overall MVPA of boys and girls per day, during the whole week, was slightly over 90 min (Table 1), which concurs with many previous studies (Husu et al., 2016, 21; Owen et al., 2009; Steele et al., 2010). It is interesting to note that girls accumulated as much MVPA as boys, because globally, boys tend to be physically more active. Studying the MVPA minutes according to the intensity levels, accumulated more through VPA than the MVPA of the girls. The quantity of average minutes was quite good. However, MVPA was not evenly distributed among the children and the ranges of measured MVPA were remarkably wide. The lowest MVPA was 46 and the highest 158 minutes (Table 1).

When comparing the MVPA between weekdays and weekend days, we found a huge difference, when children accumulated during weekend days only a half of MVPA minutes compared to

remarkably different from the previous studies (Steele et al., 2010; Trost et al., 2000). Girls accumulated more MVPA on Saturday while boys did so on Sunday. The difference on Sunday was statistically significant. The physically inactive weekend was mainly due to the exceptionally low amount of MVPA on Saturday, though Sunday was not very much better. Saturday was a rainy and cloudy day, probably resulting in less MVPA (Atkin et al., 2016; Harrison et al., 2011 & 2015; Mattocks et al., 2007; Rich, Griffiths, & Dezateux, 2012). Naturally, we can question if the children need a day to rest after the school week, or could it be that schooldays themselves provide children with lots of MVPA minutes and the proportion of leisure time is constantly low? These questions, however, remain unanswered in this study.

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6.2. Meeting the global recommendations on physical activity

The proportion of children meeting the global recommendations of daily 60 minutes MVPA was low compared to Kokko et al. (2016, p.13) and Husu et al., (2016, p.21) and much lower compared to 9 to 10-year-old children in the UK (Steele et al., 2010). However, more than 8 out of 10 children met the recommended levels at least on four days in a week, which can be considered a good result. One explanation for lower MVPA is likely the time of the year, because this study was conducted at the end of March when the weather is quite chilly and rainy, and even snowy. These are typically reasons for less MVPA (Atkin, Sharp, Harrison, Brage, & Van Sluijs, 2016; 2015; Harrison et al., 2011; Harrison, Van Sluijs, Corder, Ekelund, & Jones, 2015; Mattocks et al. 2007; Rich et al. 2012).

Contrasting the passive weekends, Tuesday and Thursday were clearly the most physically active days of the week. When we analyzed the data of meeting the global recommendations (Table 2), we noticed, that on Tuesdays and Thursdays all of the children in this study exceeded that threshold. During those days, the weather was quite nice with sunshine, implying its importance in enhancing physical activity. Previous studies have also systematically pointed out that summer, mainly due to the warmer and sunnier weather, is the most physically active time of the year (Atkin et al., 2016; Mattocks et al., 2007; Rich et al., 2012) and rain is negatively associated with MVPA in primary school children (Harrison et al., 2011 & 2015).

6.3. Schoolday MVPA

Schoolday MVPA depends partly on the number of the lessons and recesses. We were not able to

depending on their mother languages, religions and study choices. However, we used our data to add up the average number of lessons, recesses and one lunchbreak describing a hypothetical average schoolday MVPA. We ended up with a schoolday of 50 min MVPA. This would, as an average, meet the recommendation of 30 minutes per schoolday suggested by Institute of Medicine (2013) and is aligned with some studies (Nettlefold et al., 2010; Suzuki et al., 2018) but higher compared with a Finnish and an American study (Haapala et al., 2016; Weaver et al., 2016). Looking deeper into the segments of a schoolday, the average of 5 minutes MVPA accumulated in lessons align with Bailey is somewhat higher than in the studies of Sigmund et al. (2014) and Suzuki et al. (2018). There may be many reasons for differences in lesson PA, including teaching methods, class sizes, built environments and so on. Observation studies might provide more specific answers to this question.

The recesses were physically quite effective. On an average, up to 40 % of the recess time was used in MVPA. Particularly, the 30 min recess was relatively more efficient compared to the short recess. MVPA during recesses appear to be relatively slightly higher in comparison with some other studies (Nettlefold et al., 2010; Ridgers et al., 2005; Weaver et al., 2016) and aligned with Bailey et al. (2012). However, the differences are not significant. Quite likely, nicer weather on those days explains the difference between accumulated MVPA during long and short recesses in this study. (Atkin et al., 2016; Harrison et al., 2011 & 2015; Mattocks et al., 2007; Rich et al., 2012).

Lunch breaks were even more difficult to compare with other studies. The length of the lunch break and the local arrangements directly affect the time available to go to out to play with other children. However, the average of eight minutes MVPA seems to be quite good, especially when we know that children in Finland go to get their meals from the counter, go to the tables, eat and return their cutlery to the kitchen. MVPA accumulated during lunch breaks seems to be equal to the Canadian study by Nettlefold et al. (2010) and the British study by Bailey et al. (2012). Slightly more MVPA was gathered than in Japan (Suzuki et al., 2018) and slightly less compared with a study in the USA (Weaver et al., 2016). Observation studies or properly used diaries would help to assess the actual and relative MVPA of the lunch break. In our study, boys seemed to be physically slightly more active in all of the variables explored. However, the differences between boys and girls were not noticeably significant, and the few statistically significant differences are not considered very important.

7. Conclusion

In conclusion, overall MVPA was, on an average, quite acceptable. Positively, significant differences between boys and girls did not exist, though boys were slightly more active compared to girls, especially in the proportion of VPA. The worrying finding was that the range of MVPA varies greatly. Interestingly, Tuesdays and Thursdays were physically more active than other days of the week. However, these differences were, most likely, due to nicer weather on those days. Weather conditions probably affected the difference between weekdays and weekend days.

Every third girl, in comparison with every seventh boy, surprisingly met the global recommendation on daily PA. Even though, the daily PA recommendation was not met very well, almost all of the children were physically active enough on at least four days a week.

MVPA during all segments of the schoolday seemed quite decent, though there is a need to accomplish more. However, they appear to be an important part of the weekdays, providing the

especially during lessons, would certainly benefit from observation, because the validity of accelerometers may be questionable in the classroom environments.

This seven-day-period of day and night objective measurement provided us with a lot of data for further studies. In the future, accelerometers combined with well-assisted diaries and observation, would give deeper and valid insights

Schoolday PA, not sometime in the future but starting right now, should be of special concern to teacher educators, decision makers, school administration, principals, teachers and school staff to promote the well-being of children.

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